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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/801,744	03/15/2004	Woo Young Lee	P/2292-89	1821

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EXAMINER	
DICKEY, THOMAS L	

ART UNIT	PAPER NUMBER
2826	

DATE MAILED: 06/30/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/801,744	LEE ET AL.	
	Examiner	Art Unit	
	Thomas L. Dickey	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 May 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-11 and 13* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-9,11 and 13* is/are rejected.

7)☒ Claim(s) *10* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Minhloan Tran
Primary Examiner
Art Unit 2826

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *15 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☒ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Applicant's amendment filed 5/23/05 has been entered.

Status of this Action

2. Three new rejections have been made, each based in part on TAKAHASHI et al. (6,876,523), which issued in May of 2005. This Action is non-final.

Priority

3. Acknowledgment is made of applicant's claim for foreign priority based on an application filed in Korea on 03/14/2003. It is noted, however, that applicant has not filed a certified copy of the Japanese application as required by 35 U.S.C. 119(b).

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

Claim 13, as amended 5/23/05, is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 13 at present consists of a single sentence identical to claim 13 originally filed, followed by a second sentence purporting to depend from claim 1, but not adding any

limitations not already found in claim 1. More than one sentence in a single claim is indefinite. A dependent claim adding no limitation not found in a base claim is indefinite. Claim 13 will be examined under the assumption that it reads:

> 13. The hybrid ferromagnet/semiconductor spin device of claim 1, further comprising
>
> a gate,
>
> an insulating layer formed under the gate, and
>
> a two-dimensional electron gas below the insulating layer, wherein a precession of a spin-polarized carrier passed through the spin channel region is controlled by a voltage applied to the gate.

Claim Rejections - 35 USC § 103

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

A. Claims 1,2,4,5,7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over JIA ET AL. (IEEE Transactions, as cited by applicant on 1/27/05), in view of in view of TAKAHASHI et al. (6,876,523).

Jia et al. discloses a hybrid ferromagnet/semiconductor spin device with a semiconductor (selected from Si, GaAs, InAs, and Ge) substrate; a source region formed on the substrate; a spin channel region on the substrate, where a spin-polarized carrier at the

source region is injected and transported; and a drain region formed on the substrate as a ferromagnet, for detecting a spin which has passed through the spin channel region, wherein one or the other of the source region and the drain region has a line width of a range of 5-1000 nm; and an interval between the source region and the drain region is in a range of 10 nm-1 micron. Note pages 4707-4708 of Jia et al.

Jia et al. does not disclose that the source and drain regions are formed on the substrate as ferromagnets selected from one of GaMnAs, InMnAs, GeMn, and GaMnN.

However, Takahashi et al. teach that when the ferromagnetic layers of a hybrid ferromagnet/semiconductor spin device, specifically, spin-valve structure are formed of a half-metal such as InMnAs or GaMnAs, it is "considerably effective to the increase of the resistance change coefficient, that is, increase of the output," because the half-metal is capable of having a great spin polarization, even as much as 100%. Note column 4 lines 43-54 of Takahashi et al. Therefore, it would have been obvious to a person having skill in the art to replace the source and drain regions formed on the substrate as ferromagnets of Jia et al.'s hybrid ferromagnet/semiconductor spin device with the half-metal ferromagnets selected from one of GaMnAs and InMnAs, having a spin polarization of 100% (great spin polarization) such as taught by Takahashi et al. in order to considerably increase the resistance change coefficient of the hybrid ferromagnet/semiconductor spin device to thus provide an increased output.

B. Claims 1,2,4,5,7, and 9 are rejected under 35 U.S.C. 102(b) as being anticipated by HEIM ET AL. (5,465,185), in view of in view of TAKAHASHI et al. (6,876,523).

Heim et al. discloses a hybrid ferromagnet/semiconductor spin device with a semiconductor (selected from Si, GaAs, InAs, and Ge) substrate 61; a source region 63 having a line width of 7 nm (5-1000 nm) of formed on the substrate 61 as a magnet metal ferromagnet selected from Fe, Co, Ni, FeCo, and NiFe, and thus having a great spin polarization; a spin channel region 65 on the substrate 61, where a spin-polarized carrier at the source region 63 is injected and transported; and a drain region 70 having a line width of 5-1000 nm (6.5 nm, so that the source region 63 and the drain region have a different line width from each other with the result that a spin switching is anti-parallel in a certain magnet field range) formed on the substrate 61 as a ferromagnet, for detecting a spin which has passed through the spin channel region 65. Note figure 5, column 5 lines 5-30, and column 6 lines 52-54 of Heim et al.

Heim et al. does not disclose that the source and drain regions are formed on the substrate as ferromagnets selected from one of GaMnAs, InMnAs, GeMn, and GaMnN.

However, Takahashi et al. teach that when the ferromagnetic layers of a hybrid ferromagnet/semiconductor spin device, specifically, spin-valve structure are formed of a half-metal such as InMnAs or GaMnAs, it is "considerably effective to the increase of the resistance change coefficient, that is, increase of the output," because the half-metal is capable of having a great spin polarization, even as much as 100%. Note column 4 lines 43-54 of Takahashi et al. Therefore, it would have been obvious to a person having skill in the art to replace the source and drain regions formed on the substrate as ferromagnets of Heim et al.'s hybrid ferromagnet/semiconductor spin device with the

half-metal ferromagnets selected from one of GaMnAs and InMnAs, having a spin polarization of 100% (great spin polarization) such as taught by Takahashi et al. in order to considerably increase the resistance change coefficient of the hybrid ferromagnet/semiconductor spin device to thus provide an increased output.

C. Claims 1,2,4,6,11, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over JOHNSON (5,654,566), in view of TAKAHASHI et.al. 6,876,523.
With regard to claims 1,6, and 11 Johnson discloses a hybrid ferromagnet/semiconductor spin device with a semiconductor substrate 178-180; a source region 184 formed on the substrate 3; an Ohmic contact resistance between the source region 184 ferromagnet and the semiconductor substrate 178-180; a compound semiconductor spin channel region 182 on the substrate 178-180, where a spin-polarized carrier at the source region 184 is injected and transported; and a drain region 186 formed on the substrate 178-180 as a ferromagnet, for detecting a spin which has passed through the spin channel region 182. With regard to claim 13 Johnson further discloses a gate 174, an insulating layer 176 formed under the gate 174, and a two dimensional electron gas 182 below the insulating layer 176, wherein a precession of a spin-polarized carrier is controlled by a voltage 172 applied to the gate 174. Note figure 2 and column 5 lines 6-36 of Johnson.

Johnson does not disclose that the source and drain regions are formed on the substrate as ferromagnets selected from one of GaMnAs, InMnAs, GeMn, and GaMnN.

However, Takahashi et al. teach that when the ferromagnetic layers of a hybrid ferromagnet/semiconductor spin device, specifically, spin-valve structure are formed of

a half-metal such as InMnAs or GaMnAs, it is "considerably effective to the increase of the resistance change coefficient, that is, increase of the output," because the half-metal is capable of having a great spin polarization, even as much as 100%. Note column 4 lines 43-54 of Takahashi et al. Therefore, it would have been obvious to a person having skill in the art to replace the source and drain regions formed on the substrate as ferromagnets of Johnson's hybrid ferromagnet/semiconductor spin device with the half-metal ferromagnets selected from one of GaMnAs and InMnAs, having a spin polarization of 100% (great spin polarization) such as taught by Takahashi et al. in order to considerably increase the resistance change coefficient of the hybrid ferromagnet/semiconductor spin device to thus provide an increased output.

Allowable Subject Matter

6. Claim 10 is allowed over the references of record because none of these references disclosed or can be combined to yield the claimed invention such as a hybrid ferromagnet/semiconductor spin device comprising a semiconductor substrate; a source region formed on the substrate as a ferromagnet; a spin channel region on the substrate, where a spin-polarized carrier at the source region is injected and transported; and a drain region formed on the substrate as a ferromagnet, for detecting a spin which has passed through the spin channel region, wherein a surface of the semiconductor substrate where the source region and the drain region are formed is etched with a depth of a range of 10-500 nm, as recited in claim 10.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thomas L. Dickey whose telephone number is 571-272-1913. The examiner can normally be reached on Monday-Thursday 8-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J. Flynn can be reached on 571-272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TLD
06/05